

## Small-Scale Forest Related Activities in the Everyday Life of the Finns: Results of Time-Budget Studies

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**Abstract** The availability of human time and the factors affecting its allocation play an important role in the individual choices between daily activities. It can be claimed that the allocation of time for various forest related (household or recreational) activities provides one common yardstick to examine the significance of forest uses in the everyday life of ordinary people. This paper examines the time allocation of ordinary Finns (aged 10 years or over) outside of their work or school hours to selected forest-related small-scale activities derived from household needs or recreational purposes at the turn of the millennium (1999–2000), and investigates the factors affecting the time spent on forest work performed by Finnish population outside of the labour market. It was found that about 3% of total human available time was allocated in outdoor recreation or related activities. Spatially, 22% (52 h/ person/year) of total time was allocated in forest-based, 23% in water-based and the rest in mixed environment-based activities. The time spent on the consumptive nature-based recreation activities, including recreational fishing and leisure time forest work, was 43 h corresponding 19% of total time of the activities studied. The estimated time spent on forest work was higher than found in earlier studies. The amount of time used in forest work was highest among farmers, aged 60 and over, pensioners and unemployed persons. An unexpectedly large proportion of time was spend in the fuelwood production and consumption chain from forest to fireplace. The precise observations within the fixed time frame are the major advantages of the time-budget method, which however demands substantial resources for implementation.

**Keywords** Time-use survey · Forest work · Leisure · Nature-based activities

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## Introduction

As a result of economic and social trends the ecological, social and cultural aspects of Finnish small-scale forestry have become more important. Time-use surveys have demonstrated that content of working life, amount of free time and the role of nature-based outdoor recreation are in continuous change (Niemi and Pääkkönen 2001; Finnish Statistical Yearbook of Forestry 2007). Only a few decades ago, nature product gathering, hunting and fishing had significant roles as a Finnish livelihood. Nowadays, for most people, these activities are an integral part of recreational use of nature. Also, Finnish forest work performed by forest owners seems to be undergoing the same transition (Järveläinen 2007). For the Finnish society and economy, private forest ownership and forestry are still focal, although continuing fragmentation of forest holdings has reduced their roles as a main source of income (Karppinen et al. 2002).

In Finland, forestry land covers 26 M ha or 74% of the total area and 90% of the land area excluding water surfaces (Finnish Statistical Yearbook of Forestry 2007). Nearly 60% of the Finnish forests are owned by private persons. About 450,000 private forest holdings have at least 2 ha of forest land, and about 20% (1 million) of the Finnish population belongs to a forest-owning household. An average land area of forest holdings is 24 ha. Private forests provide 75% of the domestic roundwood used by industry but are also widely used for nature-based recreation (Sievänen 2001).

Forest holding provides a variety of financial benefits to owner, though seldom are the main source of livelihood. Commercial utilization of wood creates also many obligations for forest owners, in order to safeguard sustainable management of forests. The rights and obligations of forest owners are defined Forest Act and related legislation.

Every man's rights create interesting implications for uses of Finnish private forests (Rekola 1998), affording everyone vast possibilities to utilize the small-scale forests for both the consumptive and non-consumptive purposes, regardless of ownership (The Finnish Ministry of the Environment 2007). Every Finnish citizen, and foreign as well, has to right use privately owned forests for recreational purposes, even for temporary camping. In addition, people have the right to gather many non-wood forest products for household use and even utilize forests, regardless of ownership, as source of income (e.g. for commercial wild berry and mushroom gathering). Basically, the property rights of private forest holder cover 'only' the wood, restricted other plant resources, land (soil), hunting and partially fishing rights.

The studies of non-industrial private forestry have traditionally focused on the activities that are directly related to commercial roundwood removals (timber sales) and silvicultural activities (wood production). Yet, studies dating from seventies (see Järveläinen 2007; Karppinen et al. 2002) have reported that the motivations for forest ownership have been changing from economic to multi-objective orientation. Toivonen et al. (2005) pointed out that the most important objectives of Finnish private forest owners include provision of household timber, forest management work itself, forest as living surrounding, gathering non-wood forest products and forest as place for relaxing and recreation. Income from timber sales and forest as an investment or inheritance are also important, but not the highest priority.

Self-employed forest work by forest owners, voluntary work and firewood collection with the permission of the owners and free-access outdoor recreation activities by general the population include a vast array of motives, needs, values and interests. The time-use methodology presented in this study provides comparable and commensurable statistics about the magnitudes of various nature-based activities, which are difficult to acquire through more traditional means (Vaara and Saastamoinen 2002). Thus, time-use research can complement and expand knowledge on forest-related activities. Further, in the development of social account systems, time-use studies have been widely used to investigate the non-market behaviour of households and individuals for providing a more accurate assessment of economic and social welfare (Juster 1985).

### Self-performed and Recreational Forest Work in Literature

Koho et al. (2004) estimated that annual time spent by Finnish private forest owners on self-employed forestry work was approximately 7.4 M hours per year (4,650 man-years). The average number of days worked were 4.1/forest holding/year and in total of 1.24 M working days. The most popular types of work were delivery felling (13.2 h/owner/year), tending of young stands (7.4 h/owner/year) and energy wood harvesting (6.5 h/owner/year). The number of hours worked were converted from productivity estimates of various types of work (ha/hour and m<sup>3</sup>/hour), expressing more likely 'efficient working time' than total working time.

Some comparable but rough time-use estimates can be introduced from official labour statistics (Finnish Statistical Yearbook of Forestry 2007). For example, in 2000–06 the amount of days actually worked in forestry by self-employed persons varied between 1.48 and 1.56 M, meaning about 11–12 M working hours and 6,000–7,500 man-years per year (taking a working day as 7.5 h). The estimated number of hours worked by self-employed non-industrial forest owners in Sweden in 2002 was 12.1 M (National Board of Forestry 1994).

Some statistics of forest work activity are also available in the *Outdoor Recreation 2000* study of Sievänen (2001), which reported that about 0.390 M Finns aged 15–74 (10% of population) years had participated on average of 10 times (in total about 3.9 M times) in recreational forest management in 2000. Respectively, 1.15 M Finns (30%) participated an average of 10 times (in total about 11–12 M times) in fuelwood gathering activities during their leisure time. In addition, the study reported that nearly all Finns (97%) participate in some nature-based recreational activity at least once in the course of year.

Work related to fuelwood production and consumption is an important part of Finnish everyday life. Fuelwood accounts for about 6.5% of total annual roundwood consumption and 11.5% of total annual roundwood removals from Finnish private forests (Sevola et al. 2003; Finnish Statistical Yearbook of Forestry 2007). About 93% of farms, 80% of detached houses and 90% of summer cottages used wood for additional heating (Tuomi and Peltola 2002). The total amount of roundwood used for energy generation by small dwellings was 5.2–6.0 M m<sup>3</sup> over 2000–06. The share of self-driven fuelwood supply covers about 70% of total use. About 54% of

fuelwood is provided from own forests, and 20% is collected from forests of other owners. The total time spent on these everyday activities is still unknown.

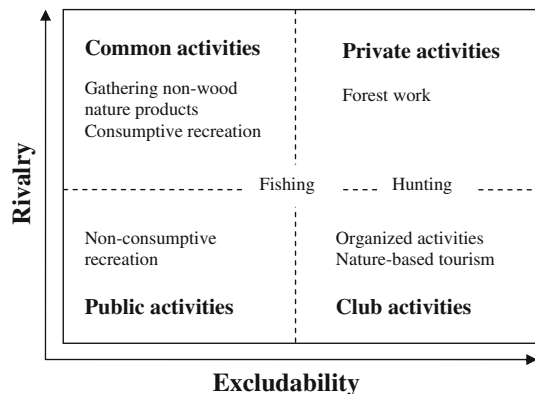
### Conceptual Framework

Merlo et al. (2000) developed a conceptual framework to classify nature-based activities and uses of forests into public activities and private activities, ranged according to the rivalry and excludability (Fig. 1). The extraction of rival forest products by an individual excludes other consumers. Even if the nature products are basically renewable, the temporal and spatial nature of products makes them more or less scarce. Excludability refers to the particular nature-based activities that are restricted to those who are entitled to engage activities and those who are paid a fee (market price) for the achieving activity. The pure public activities denote extreme cases, which are fully non-rival and fully non-excludable, and hence fully available to the public. Respectively, the pure private activities are fully rival and fully excludable, and so available only for forest or resource owners.

In Finland, typical *private* activities consist of forest work, hunting and partially fishing, and extraction of soil or lichen. The landholder does not own the game or fish, but has hunting and major fishing rights. *Public* activities cover the non-consumptive nature-based activities such as walking for various purposes, skiing and nature watching (Fig. 1). The *common* activities hold a place somewhere between public and private goods. Availability of common activities is basically free (public) for everybody, but restricted by scarcity of natural resources. In Finland, the most popular common activities are gathering of wild berries, mushrooms and other non-wood products (Pouta and Sievänen 2001). The *club* activities are excludable but not rival. In many cases, the club activities are available only due to the permission of landholder or activity participation is restricted by fees or controlled by legislation.

In practice, pure rival and non-rival activities or pure excludable and non-excludable activities do not exist. For example, availability of forest non-wood products such as wild berries may vary spatially or temporally (crop fluctuation) and forest recreation as a public good may suffer from congestion or private uses of

**Fig. 1** Taxonomy of nature-based activities using rivalry and excludability



forests (clear cuttings). Even the self-employed forest work is controlled by many legislative acts and forest management recommendations. Hunting and fishing are basically consumptive uses of forests and they hold many characteristics of common, private and club activities (Fig. 1). For example, fishing on ice with line and angling are free (no nationwide fishery fees) for everybody, and lure fishing is free for people aged below 18 and 65 years or over. In Finland, hunting is in principle free for anybody who has passed hunting exam and paid a game management fee, but the real opportunities to participate in hunting depend on many factors, including being a holder of the hunting rights (as a land owner or member of a hunting club).

### Hypotheses and Objectives of Study

The time-budget methodology utilized in this study rests on a ‘zero-sum’ principle. The activities recorded from time-use diaries are mutually exclusive, meaning that time consumed in a particular activity is not available for any other activity. The first hypothesis is a general one:

**Hypothesis 1** A time-budget method provides both complementary and new data on the importance of the activities based on precise recording of time used.

The specified hypotheses are related to self-performed forest work. In the long rotation of forests, the time between silvicultural activities and logging operations is long compared to the daily recreational uses of forests. Since a direct interaction between people and small-scale private forests is applied as a criterion, the forest work engaged in by forest owners and other population members is only a minor part of total amount of use. That leads to the second hypothesis:

**Hypothesis 2** The average time spent on forest work performed outside the labour market by Finns is minor compared to other direct uses of forests.

In Finland, surveys concerning the self-activity of small-scale forest holders have traditionally focused on forestry work conducted by forest owners and household members on their own forest holdings (Etelätaalo 1989; Hämäläinen and Kettunen 2001; Hänninen et al. 2001; Koho et al. 2004). Also the term ‘self-employed’ refers to work carried out by forest owners themselves. In this study, time spent on forest work will be for the first time examined at a population level, regardless of forest ownership. That leads to the hypothesis:

**Hypothesis 3** The total time devoted to forest work outside the labour market by Finns is more substantial than the existing research and labour statistics have reported.

The perspective of private forestry research has traditionally been highly income or wood production oriented. For example, in the study by Koho et al. (2004), the sample was restricted to private forest holdings of at least 5 ha, which excluded more than 150,000 smaller forest holdings. Also, only work involved in the most important economic and silvicultural measures were observed.

Private forest holder's behaviour has usually been explained in relation to the characteristics of the head of forest owning household, not the individuals actually involved in forest work (Etelätaalo 1989; Hämäläinen and Kettunen 2001; Hänninen et al. 2001; Koho et al. 2004). In addition, the interests of studies have usually focused on factors that focus more on working ability and work efficiency than on time spent on activities (Koho et al. 2004). This leads to the fourth hypothesis:

**Hypothesis 4** The determinants of time spent on forest work are more diverse than earlier studies have reported.

Koho et al. (2004) and Karppinen et al. (2002) reported that probability to participate and allocate time in self-employed forestry work is highest among younger forest owners because of their higher working ability. Pouta and Sievänen (2001) reported that the annual frequencies of participation in recreational forest management work and fuelwood gathering are highest among people aged 65–74 years.

The objectives of this study have been to

- construct the time-use matrixes of the various non-consumptive and consumptive nature-based activities performed by the Finnish population;
- estimate the numbers of working days and amounts of time allocated for various types of forest work by Finns;
- identify the determinants of forest work participation and time-use by Finns;
- construct a time-use matrix that illustrates the time allocation for fuelwood production and consumption activities among the Finnish population.

## Research Method

This research drew on data collected in the *Finnish time-use study*. At present, time-use surveys are widespread practice and for example nearly all EU countries have undertaken at least one time-use survey (Eurostat 2004). Statistics Finland has carried out three time-use surveys, in 1979, 1987–88 and 1999–2000 (Niemi 1983; Niemi and Pääkkönen 1990; Pääkkönen and Niemi 2002).

The Finnish Time-Use Survey 1999–2000 was carried out according to the Eurostat guidelines as a part of harmonized European Time-Use Surveys (Eurostat 2004). The dataset consists of three parts: individual self-completed diaries and household and individual level questionnaires. The household and individual level questionnaires were completed by interview before the diaries were collected. Selected respondents aged 10 years or over kept diaries for two full day (24-h) periods, one weekday and one weekend day, recording by their own words the all primary and secondary activities they performed in fixed 10-min intervals within a structured diary format. The survey period covered a full year from March 1999 to April 2000 (Niemi and Pääkkönen 2001; Väisänen 2001, 2002a, b). In total, the sample included 10,278 individuals of whom 6,272 kept a diary at least for 1 day resulting in time-use data for 10,561 days (Table 1).

**Table 1** Sample design of the original time-use survey data of Statistic Finland 1999–2000 and sample size used in this study

Survey period	1.3.1999–29.2.2000
Target unit	Household and individual
Data size (clusters)	3,011 households
Data size (units)	6,272 individuals
Data size (days)	10,561 days
Diary days	Weekday and weekend day
Diary interval	10 min, 144 time-slots per day
Response rates	56% of households, 52% of individuals

The sampling design was two-phase, single-stage cluster sampling, where households served as clusters and individuals were the elementary units. The sample was drawn from the Population Register using a Master Sample (of 42,047 households). In the first phase, a Master Sample was drawn from individuals aged 15 or over. In the second phase, all individuals aged 10 or over in the household-dwelling unit concerned were selected as a target population (Väisänen 2001, 2002a, b).

Household and diary weights were used to correct for non-response and balancing days of the week at both household and individual level. The diary weights for each respondent are derived as the product of the master sample weight (sample drawn from Population Register), the weight of the time-use study sample, household level non-response adjustment weight, calibration weight of demographic data, diary allocation weight and balancing weight of a diary day. More details about the sampling and estimation procedures are available in Niemi and Pääkkönen (2001), Väisänen (2001) and Eurostat (2004).

The primary data of this study consist of all the observations concerning forest and nature-related activities as well as small-scale wood-material-related activities, picked manually from the original daily time-use diaries. A time-lag arose between the original survey and this paper because permission to use the original time-use diaries from the Ethical Board of Statistics Finland was not granted until 2004. Further, part of analysis was delayed because Statistic Finland found some mistakes in the original household level background variables they had provided, and the corrected background data set was not available until 2007.

### Activity Classification

In principle, the time-use diary approach offers the most accurate method of obtaining data on time allocation of everyday activities (Harvey 1984; Niemi 1993). The time-use methodology is a combination of qualitative and quantitative data analysis. The interpretation and classification of free-form diary descriptions are the fundamental parts of analysis. In this study, utilizing original diaries all observations describing the outdoor recreation and related consumptive uses of nature, forest work and fuelwood production and consumption activities were recorded. An acceptable observation contained primary activity performed, times of beginning and finishing of activity, possible secondary activities performed, and further details

of activity described by respondent (e.g. motives, spatial location). Diary descriptions separate the recreational, self-employed, voluntary and other occasional forest working episodes from full-time paid work done by wage earners, salaried employees and hired labour.

Nature-based activities (including forest work) have been divided in 22 broad activity groups (Table 2) and divided further for more detailed descriptive analysis. For example, gathering of nature products is divided in wild berry picking, wild mushroom picking and other nature product collecting. The nature-based activities are also classified into three categories according to the main component of environment where they occur: forests, waters and mixed environments (Table 2). 'Mixed environment' is a transition zone composed of roads and areas between forests and waters.

**Table 2** Classification system adopted for nature-based activities

Activity group	Activities	Environment
Forest work	Roundwood harvesting, planting, tending of seedling stands, other silvicultural work, fuelwood harvesting	Forests
Hunting	Moose, deer and small game hunting	Forests
Gathering nature products	Picking berries, mushrooms and other nature products	Forests
Walking in forest	Hiking/backpacking, day trips, walking	Forests
Cross-country skiing	For fitness/pleasure and backpacking	Forests
Downhill skiing	Slalom, telemark, snowboarding	Forests <sup>a</sup>
Motorized activity	Snowmobiling and others	Forests
Other forest-based activities	Orienteering, rock climbing, horseback riding, dog training, sledging, sliding	Forests
Fishing	Net/trap, trolling, angling, casting/fly-casting, ice fishing	Waters
Boating	Motor boating, sailing, fishing by boat excluded	Waters
Rowing/canoeing	Fishing by rowboat excluded	Waters
Swimming		Waters
Staying on waterside	Sunbathing, playing, picnicking	Waters
Walking on waterside	For different purposes	Waters
Working on waterside	Maintenance of boat or landing, water management works	Waters
Other water-based activities	Surfing, diving, etc.	Waters
Walking for fitness/pleasure		Mixed
Walking with child		Mixed
Walking with dog		Mixed
Jogging		Mixed
Bicycling	For fitness and long distance cycling	Mixed
Other activities in mixed environment	Kick sledging, roller skating, horse riding	Mixed

<sup>a</sup> In many downhill areas in the north, the upper part of slopes includes treeless fell (mountain) areas



Forest work conducted by private forest owners and other voluntary workers are divided into five categories:

*Roundwood harvesting*: intermediate and regeneration fellings, forest haulage, stacking the roundwood.

*Fuelwood harvesting*: fuelwood cutting, gathering cutting residuals, fuelwood production activities in forest, chopping, forest haulage, stacking fuelwood in forest.

*Tending of young stands*: tending of seedling stands, improvement of young stands, pruning.

*Planting*: initial and supplementary planting.

*Planning*: checking, planning of fellings in forest.

The forest work episodes are classified according to the primary activity description. In practice, the most of activities related to forest work are joint production processes. Roundwood harvesting may produce timber for sale or household use and cutting residuals (fuelwood). From a silvicultural point of view thinning or tending of young stand can be interpreted as the same activity, yet a forest owner may consider this activity primarily as fuelwood production. In addition to fuelwood production related operations in forest environment, also time spent on fuelwood production (chopping, storing) and consumption activities performed at home are identified.

## Descriptive Analysis

Time-use data may be analysed by descriptive or explorative methods. The former consists of constructing a time-use matrix (24 h time-budgets) with selected time-use categories for various population groups. The latter involves microeconomic modeling of individual behaviour.

The observed daily time spent on a particular activity is a major behavioral indicator in time-use methodology. Positive values of time-use indicate the extent of participation during the time span while zero values indicate non-participation. Time spent observations offer numerous calculable estimators (Harvey 1984; Eurostat 2004). The average daily time spent on activity per individual ( $T$ ) is estimated as

$$T = \frac{\sum t_{ip} W_{ip}}{N} \quad (1)$$

Average daily participation rate on activity of population ( $D$ ) is estimated as

$$D = \frac{\sum d_{ip} W_{ip}}{N} \quad (2)$$

Average daily time spent by those who participated in daily activity ( $TD$ ) can be calculated by including only those persons who spent more than 0 min on activity:

$$TD = \frac{\sum td_{ip} W_{ip}}{N_{td}} \quad (3)$$

In Eq. 1  $t_{ip}$  denotes time spent on activity by person  $i$  during diary day  $p$  in minutes. In Eq. 2  $d_{ip} = 1$ , if  $t_{ip} > 0$ , and  $d_{ip} = 0$ , if  $t_{ip} = 0$ , while in Eq. 3  $td_{ip}$  denotes time

spent on activity by person  $i$  during diary day  $p$  in minutes and is observed, if  $t_{ip} > 0$  and  $d_{ip} = 1$ .  $W_i$  denotes diary weight by person  $i$  during a diary day.  $N$  and  $N_{id}$  denote the size of population under consideration. A sum of diary weights ( $W_i$ ) is invariably the size of population ( $N$ ). For the Finnish population aged 10 or over,  $N = \sum W_i = 4,451,390$ . The average time spent on activity  $T$  is calculated over the whole group of persons that are investigated and averaged across the whole year. This means that all individuals are included, whether they have performed a particular activity or not. The several behavioral estimators can be introduced from Eqs. 1–3, such as

- average annual time spent on activity per individual =  $T \cdot 365$ ;
- total annual time spent on activity by whole population group =  $T \cdot 365 \cdot N$ ;
- average annual frequency of participation (days per person per year) =  $D \cdot 365$ ;
- total annual number of days of participation for whole population group =  $D \cdot 365 \cdot N$ .

For forest work, the factors affecting participation, level of participation (daily time spent by participants) and time spent by the whole population are investigated utilizing both the descriptive and explorative methods. In descriptive analysis the statistical differences between selected population groups are tested using either the  $t$ -test (two categories) or Tukey's post hoc test (more than two categories).

### Multivariate Analysis of Time-Use Data

In multivariate analysis, factors affecting the propensity to participate in forest work and amount of time spent among participants were studied using so-called two-part models by Duan et al. (1983) and Cragg (1971) and a two-stage model by Heckman (1979). The two-part analysis utilizes a binary choice models for participation (probit or logit) and a linear models for level of participation (OLS or truncated regression). In this study, logistic regression is chosen to estimate participation, because of its ability of report both the odds ratios and marginal effects of independent variable on the dependent variable. Truncated regression analysis is chosen to estimate level of participation.

A sample design of time-use data—especially the many zero observations—creates particular challenges for the choice of multivariate method. Klevmarken (1999) pointed out, that the problem may arise due to short data collecting periods (24 h diary): an individual never participates in activity or an individual usually participate in activity but did not participate, for some reason, during any of the selected diary day. The most frequently applied approaches to handling a zero problem is the standard Tobit model (Tobin 1958). In this study, the standard tobit model is rejected because of its assumption that the same factors that affect the probability of participation also explain the expected time spent by the participant, and what is more restrictive, the tobit assumes that the affect is in same direction (see Siegelman and Zeng 1999). The Heckman two-stage procedure adopted avoids these restrictions.

Heckman model consist of the two stages (Heckman 1979; Greene 2000). First, the propensity of participation is estimated using a logit model and the inverse

Mill's ratio (IMR) is calculated for each respondent. In the second step, the ordinary least squares regression (OLS) for the participants is estimated including the IMR as an additional independent variable to indicate the effect of the participation decision on the time-use decision. IMR is the ratio between the density and cumulative distribution functions of the standard normal distribution (Greene 2000). If the error terms of the logit and OLS regression model are uncorrelated and IMR as an additional independent variable (second stage OLS) is not statistically significant, the simple two-part model may be an appropriate estimation technique. Sartori (2003) pointed out that the Heckman procedure is appropriate only, if there are exclusion restrictions, in other words, at least one independent variable that effects the participation decision (included in first stage), but does not affect the time-spent decision (excluded from second stage). An exclusion restriction is needed to avoid collinearity problems between IMR and other independent variables.

The objective of this part of the study is to investigate the actual behaviour, so only the marginal effects of two-part models are reported (together with odds ratios from logistic regression). Also, the unconditional marginal effects of time-use by the whole population are computed from Heckman models (following Siegelman and Zeng 1999).

### Variables in the Analysis

The population groups in descriptive analysis and independent variables in multivariate analysis are selected according to earlier studies. The signs of recreationally oriented forest workers are based on statistics reported by Pouta and Sievänen (2001) and respectively the signs of economically oriented forest workers are based on small-scale forestry surveys conducted by Karppinen et al. (2002) and Koho et al. (2004).

The composition of household members may affect amount of time allocated in forest work in two ways (Table 3). Pouta and Sievänen (2001) reported that belonging in a family with a young child and a belonging in a family with more than one adult increase demand for recreational forest management. Gronau (1977) pointed out that the intra-household distribution of work and availability of household labour affect time-allocation decisions of household members. The more adults in the household the smaller the average time distribution per person is needed for achieving the goals related to forest work. Also, a young child may decrease the amount of time available in forest work (Table 3).

Ownership of a summer cottage may increase time spent on forest work, because a cottage plot or free-time residence estate is often part of forest estate or a cottage plot is often more or less forested (Sevola et al. 2003) (Table 3). Living in an urban area decreases the tendency to participate in forestry work (Pouta and Sievänen 2001; Karppinen et al. 2002). In this study, household income are measured in two ways: total gross household income (descriptive analysis) and average gross income of household per household member (multivariate analysis). Koho et al. (2004) reported that the propensity to participate in self-employed forestry work is highest among those falling in middle income brackets. The effects of temporal dimensions on the amount of forest work are unknown.

**Table 3** Expected signs of coefficients in time-related analysis

Variable	Recreational orientation	Economic orientation	Expected sign in time-use data
Male	+	+	+
Age below 40	—	+	+
Pensioner	+	(—)	+
Employed	0	+	+
Unemployed	0	—	—
Farmer	+	+	+
Family with child under 18 years	+	?	+(—)
One adult household	—	?	—(+)
Total income of household, middle	?	+	+
Average income/member, middle	?	?	
Urban dweller	—	—	—
Freetime residence owner	?	?	+
Winter (January, February, March)	?	?	
Weekend	?	?	

**Table 4** Time-use matrix of time spent on nature-based activities and environments by the Finnish population aged 10 years or over (hours/person/year)

Forests	Water		Mixed environments		
Forest work	8.1	Boating	4.6	Walking for fitness/pleasure	62.8
Hunting	5.2	Rowing/canoeing	0.9	Walking with dog	29.3
Gathering nature products	9.5	Swimming	7.8	Walking with child	6.7
Hiking/backpacking	2.3	Fishing	20.2	Jogging	4.7
Walking: day trips	5.5	Staying: waterside	12.3	Bicycling	18.0
Walking in forest	4.4	Walking: waterside	1.2	Other activities	4.1
Skiing for fitness	2.6	Tasks: waterside	4.8		
Skiing: day trips/backpacking	5.6	Other activities	0.8		
Downhill skiing	4.9				
Motorized activity	1.2				
Other activities	2.3				
Total	51.5		52.6		125.5

## Results of the Multivariate Analysis

### Time Spent on Nature-Based Activities and Nature Environments

In total, the average annual time spent on nature-based activities (excluding in urban areas and parks and build outdoor facilities) by the Finnish population aged 10 years or over is about 230 h/person/year (Table 4). Approximately 3.0% out of total

**Table 5** Time-use matrix of time spent on nature-based consumptive activities by the Finnish population aged 10 or over

Activity	Product/type of activity	Annual time spent (M hours/year)	Annual time spent (man-years) <sup>a</sup>
Picking	Wild berries	33.4	19,600
	Wild mushrooms	4.0	2,360
	Other products	4.9	2,880
Hunting	Moose/deer	11.1	6,550
	Small game	12.0	7,070
Fishing	Net/trap	14.6	8,580
	Trolling	10.7	6,280
	On ice with line	18.5	10,850
	Angling	11.4	6,700
	Casting	29.4	17,300
	Other types	5.3	3,110
Total		155.2	91,300

<sup>a</sup> Total annual time spent on activities by entire population, in M hours/year and man-years (one man-year = 1,700 h)

human available time is allocated in activities defined in this study. About 22% (51.5 h) of total time is allocated to forest-based activities. The average time spent on the consumptive nature-based activities as a primary activity including fishing and forest work is 43 h, corresponding 19% of total time devoted to outdoor recreation (Table 4).

Gathering nature products (9.5 h/person/year), cross-country skiing (8.2 h/person/year) and forest working (8.1 h/person/year) represent the most popular single forest-based activities (Table 4). Average annual time spent on hunting totals 5.2 h, and fishing of all types 20.2 h. Mixed environments offer the easiest way for enjoying, watching and observing nature. Walking for witness and pleasure and walking with child and dog are typical daily outdoor recreation activities performed close to home. Time spent on these walking activities (in total 105.5 h/year) exceeds slightly time spent on forest and water-based activities together (104.1 h).

### Time Spent on Consumptive Nature-Based Activities

The average time spent on picking nature products, hunting and fishing by Finnish population aged 10 and over is 34.9 h/person/year, or 155.2 M hours when aggregated over the national population (Table 5). Time spent on activities measured by man-years is more than 90,000. Total time spent on wild berry picking is 33.4 M hours and 19,600 man-years. About half the total time devoted to hunting is allocated in moose or deer hunting. Fishing as a leisure activity is achievable all year round due to on-ice fishing, so the time devoted on fishing is considerable comparing to seasonal hunting and gathering activities. About 44% (40 M hours) of the total time devoted to fishing arises from *everyman's rights* (common rights for

**Table 6** Time spent on forest work performed by Finnish population aged 10 and over

Type of work	Average time spent (hour/person/year)	Participants time spent (min/day)	Total time (M hour/year)	Total time (M days/year)	Annual working time (man years)
Roundwood harvesting	2.6	234	11.58	2.97	6,800
Fuelwood harvesting	2.0	204	8.82	2.60	5,200
Tending of young stand	2.4	248	10.86	2.63	6,400
Planting	0.7	292	3.17	0.65	1,900
Planning	0.4	138	1.62	0.70	950
Forest work in total	8.1	226	36.05	9.56	21,200

angling, fishing on ice with line and lure fishing by persons aged 10–17 and 65 and over).

### Time Spent on Forest Work

Total time engaged in forest work (excluding market-oriented full-time work) by the entire Finnish population aged 10 years and over is 36.05 M hours (Table 6). The annual number of working days is 9.56 M and the average working day length is 3 h 46 min, corresponding to 21,200 man-years. The most time-consuming types of forest works are roundwood harvesting, tending of young stands and fuelwood harvesting. The average working day duration is highest among those who engage in planting (4 h 52 min/participant/day). There are no significant differences in numbers of annual working days between three most popular types of forest work. A slight difference in total hours devoted to fuelwood harvesting and tending of young stand arises from the differing average lengths of working days (Table 6).

### Factors Affecting Propensity to Participate and Use Time in Forest Work

The determinants of forest work participation and time-use are investigated among population aged 10 or over using descriptive means (Table 7), and among the population aged 18 years or over using multivariate analysis (Table 8). The both tables indicate that the determinants of participation and time-use decisions differ.

All selected population groups differ significantly ( $P < 10\%$ ) with respect to average time allocated to forest work, except summer cottage ownership (Table 7). The last column in Table 7 show how annual time spent is composed of annual frequency of participation and working day duration. The annual average time spent (hours/person/year) on forest work is highest among males, aged 60 years or over, pensioners and unemployed. Age is an important determinant of time use. An average age of forest worker is 55 years, being lowest among those who participate in planting (36 years) and highest among those who engage in fuelwood harvesting

**Table 7** Average time spent on forest work, average annual number of days of participation and average daily time spent by participants among population aged 10 or over

Population group	Time spent (hours/person/year)	Participation (days/person/year)	Time spent (min/participant/day)
Male	15.1*	4.1*	220*
Female	2.0	0.4	286
	$F = 7.04, P = 0.000$	$F = 10.76, P = 0.000$	$F = 3.82, P = 0.018$
Age 60 or over_a	16.6_bcd	4.8_bcd	206_bc
Age 10–24_b	1.3_acd	0.4_ad	181_acd
Age 25–44_c	6.4_ab	1.4_a	265_ab
Age 45–59_d	8.4_ab	2.1_ab	242_b
	$F = 8.34, P = 0.000$	$F = 9.97, P = 0.000$	$F = 3.42, P = 0.029$
Pensioner_a	17.5_bd	4.9_bcd	215_cd
Employed_b	7.6_acd	1.9_ad	236_d
Unemployd_c	13.5_bd	3.0_ad	269_ad
Other_d	0.7_abc	0.3_abc	122_abc
	$F = 3.16, P = 0.014$	$F = 4.98, P = 0.038$	$F = 4.91, P = 0.004$
Income deciles 1–2_a	12.3_cd	2.8_c	268_bc
Income deciles 3–5_b	8.6_c	2.4_c	204_ac
Income deciles 6–8_c	3.5_abd	1.4_ab	160_abd
Income deciles 9–10_d	8.0_ac	1.8	258_c
	$F = 20.11, P = 0.000$	$F = 25.98, P = 0.000$	$F = 2.95, P = 0.046$
Sparsely populated area_a	22.0_bc	6.1_bc	216_b
Rural centre_b	8.6_ac	1.9_a	275_ac
Urban_c	3.4_ab	1.0_a	211_b
	$F = 5.76, P = 0.005$	$F = 4.78, P = 0.008$	$F = 3.66, P = 0.022$
No child below18_a	10.2_bc	2.6_bc	233_bc
Youngest child aged < 7_b	1.7_a	0.6_a	166_a
Youngest child aged 7–17_c	2.2_a	0.8_a	158_a
	$F = 2.22, P = 0.075$	$F = 0.32, P = 0.795$	$F = 5.76, P = 0.005$
Adults 1_a	11.4_b	2.3	297_bc
Adults 2_b	6.6_a	2.0	203_a
Adults > 2_c	8.5	2.4	207_a
Summer cottage	9.7	2.9*	198*
No-summer cottage	7.3	1.8	249
Farmer	63.6*	16.6*	234
Farmer plus household member	44.8*	11.6*	243
Total	8.1	2.1	226

\* Pairwise comparison, *t*-test, significant at the 10% level

Letters indicate (abcd) multiple comparison, Tukey's test, significant at the 10% level

(60 years). The household factors that increase individual's annual time spent on activity are belonging to low income household, living in a sparsely populated area and living in a household with no young child (Table 7).

A high annual time spent on work mainly originates from high frequency of participation, except for the number of adults and total household income level (Table 7). The number of adults does not affect frequency of participation by individuals ( $P > 10\%$ ), but affect the average duration of working days by participants. Number of days of participation among unemployed is statistically lower than among pensioners, but the daily time spent by unemployed participants is significantly higher than by pensioners. The summer cottage owner participates in forest work more frequently, but the average duration of their working day is lower than among non-owners (Table 7). About 21% of annual total time spent (and 28% of participation days) on forest work by the Finnish population is consumed during cottage visits.

As expected, average time spent on forest work among agricultural entrepreneurs is high compared to other population groups (Table 7). Farmers devote nearly 64 h/person/year to forest work, with an average frequency of participation of 16.6 days a year. The average time spent by both farmers and the other members of households is 45 h/person/year (Table 7).

Results from Heckman two-stage procedure indicate that a decision to participate in forest work do not affect the time-use decision of participants (Table 8). The correlation between error terms of participation and time-use decisions is nearly zero ( $r = 0.099$ ) and effect of IMR is not statistically significant ( $P > 10\%$ ). The marginal effects from truncated regression model are nearly identical with conditional marginal effects from Heckman second stage OLS (Table 8).

The Heckman estimation results reveal that each variable under consideration except unemployment, is related to the unconditional time spent on forest work, at the 10% significance level (Table 8). The unconditional marginal effects reveal that belonging to a middle income class, one-adult household and cottage -owning household increases average time spent. In addition, location of residence affects time spent (unconditional mean): time spent is high among those who live in Eastern Finland and low among urban dwellers. Individuals aged below 40 years allocate an average of 4.5 h less time for forest work than other population members. The logistic and truncated regression results as well as conditional means from the Heckman model (fourth column of numbers) show how unconditional means are decomposed into the participation decision and the time-use decision by participants. One interesting feature of the two-part model and Heckman's two-stage model is that determinants of daily participation and time-use by participants differ. For example, the lower age of respondent is associated with lower propensity to participate, and with higher level of participation (time-spent). Being a male, cottage owner, urban dweller or belonging to particular income groups affect significantly the individuals propensity to participate (first and second columns of numbers), but do not affect the time spent by those who actually participated (third and fourth columns of numbers) (Table 8).

Daily propensity to participate in forest work is higher during the autumn (September–December) and spring months (April–May) compared with winter (January–March) and summer (June–August). The average length of working day is shortest in summer. The participation decision dominates over the time-spent



**Table 8** Multivariate analysis findings on factors affecting the forest work participation and time use among adult population (aged 18 years or over)

Independent variables	Logistic regression odds ratio	Logistic regression margins (days/year)	Truncated regression margins (min/day)	Heckman conditional margins (min/day)	Heckman unconditional margins (hours/year)
Male	10.76*	2.4*	−6		14.9*
Age below 40	0.42*	−0.6*	78*	76*	−4.5*
Unemployed	1.19	0.6	9	8	3.6
Urban dweller	0.30*	−1.3*	−39	−39	−11.6*
Located in eastern Finland	2.66*	1.3*	40*	40*	15.0*
Cottage holder	1.80*	0.6*	−11	−10	4.2*
Income deciles 1–2	0.45*	−0.6*	−7	−8	−6.1*
Income deciles 3–8	Reference group				
Income deciles 9–10	0.39*	−0.6*	14	10	−7.0*
One-adult household	1.82*	0.7*	132*	130*	7.7*
					min/day
Weekend	1.10		−22	−21	−0.1
Winter	Reference group				
Spring	1.98*		−17	−13	1.3*
Summer	0.65		−110*	−103*	−0.5
Autumn	1.71*		−13	−11	0.7*
IMR				7	
Sigma <sup>a</sup>			73*		
Rho				0.099	
Log likelihood	−296.13		−334.01	−396.22	

\* Significant at the 10% level

<sup>a</sup> Estimated standard error of the regression

decision by participants: unconditional daily time spent is significantly greater during spring and autumn than during winter and summer (Table 8).

### Time Spent on Fuelwood Production and Consumption

Table 9 illustrates that the work time allocated in fuelwood production- and consumption-related activities is a huge but ‘invisible’ part of everyday life of Finns. People allocate 175 M hours per year and total of 103,200 man-years for activities related to fuelwood production and consumption (Table 9). The time spent in fuelwood production in forests (8.82 M hours) covers only about 8% of total amount of time allocated in productive activities (105.9 M hours/year). The most time-consuming stage in the fuelwood production chain is performed at home or summer cottage yard: the time spent on splitting, shopping, storing and related work is about 97 M hours per year (57,000 man-years). Time allocated in activities related to fuelwood consumption totals 41,000 man-years.

**Table 9** Total time spent on fuelwood production and consumption work by the entire Finnish population and annual working time measured by man-years

Type of activity	Environment or purpose	Total time spent million hours/year	Annual working time man-years
Production	In forest	8.82	5,200
	At home/cottage	97.07	57,100
Consumption	Boiler	5.62	3,310
	Fireplace	9.74	5,730
	Cooking-stove	2.74	1,600
	Stove/oven	13.75	8,090
	Fire on yard/grill	6.56	3,860
	Sauna	31.11	18,300
Fuelwood work	Total	175.41	103,200

## Discussion

The analysis of time-budget data and results presented in this study provide new information about forest work performed by the Finnish population. The annual amount of time allocated in self-performed forest work by forest owners and voluntary forest work by other population (21,200 man-years) is considerably higher than the previous studies indicate. It is comparable with many popular recreational and consumptive uses of forest. It is also approximately equal to total working time of employed persons in forestry, which varied between 21,000 and 24,000 man-years during 1997–2007 (Finnish Statistical Yearbook of Forestry 2007). An explanation is that the many of the smallest scale activities, for example those occurring on or near summer cottages—have not been adequately covered by other studies, which have focused on behaviour of forest owners and ignored unpaid work by others. This study show that there is substantial work time-input by the Finnish population, which of course is ‘less’ efficient in economic or silvicultural meaning but has great importance for the people involved, particularly in small forest estates, sized below 5 ha. The economic significance of smallest forest holding may be limited, but nevertheless offers opportunities for enjoyable and useful time spent.

Farmers and members of farm households are the most active forest worker group. There are many reasons for the high activity of farmers: forests are still a significant source of income to farmers, and the average forest area owned by farmers is relative large compared to other owners. Farmers lives close to forest estates, household use of lumber and fuelwood among farmers is considerable, and farmers have skills and equipments to engage in many types of forest work. The forest work activity is highest among those population groups who have a more available free time (do not belong to the labour force) such as the pensioners, aged 60 years or over, and unemployed persons.

Among other findings is the importance of forest work in Finnish free time residence dwellings. Summer cottage ownership effects positively forest work

participation, and notably the major part of total forest work by Finnish population is performed during cottage visits. This activeness of cottage owners is not surprising, because for example Sevola et al. (2003) reported that about half of cottage properties are composed partially of forest area.

The final significant implication of this study is the considerable amount of time devoted to firewood production and consumption activities by Finns. Only a small part of these activities occurs in the forest and most time is consumed in the yards for making and storing firewood and in houses for activities related to burning wood.

In regard to other than forest work-related activities the results of this study are mostly complementary to the previous studies, in particular to *Outdoor recreation 2000* study (Sievänen 2001). Regardless of purpose and environment, walking is the most popular activity (124 h/person/year) as in earlier studies. However, there are differences in 'importance' of activities when measured by participation rates or actual time use. For example, according to Sievänen (2001) 56% of population picked wild berries and 8% did hunting. The time-use estimates presented here make the difference less drastic: at least in 2000, which was a low crop year for berries, the total time used for hunting was about half of that of wild berry picking.

The time-use methodology provides a powerful tool for measuring and analyzing objectively numerous aspects of human behavior in a wide variety of activities, places and purposes. The time-diary as a data collecting method has proven to be one of the most accurate instruments to list everyday human activities (Niemi 1983). It can be concluded that the time-use methodology is useful in its capacity to catch many small everyday activities and measure the time used for them in an objective way. The time-use findings suggest that more attention should be paid to many forms of forest work done by non-forest owners on forestry land or forested areas belonging to other land use categories. Accurate time-use data may provide possibilities for a wide variety of modeling efforts, e.g. modeling the joint production of berry picking for household use or multistage modeling of sequential decisions related to fuelwood production and consumption.

Although time is indeed a kind of common if not universal yardstick to measure at least some components activity importance, the methodology as such is much more limited in its scope than survey methods. In particular, daily recording based on a national sample is highly expensive and for national scale studies even for official statistical institutions implementable only at long intervals. Permission to use the next comprehensive time budget data collected by Statistics Finland (during 2009–2010) may not be available before 2014.

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